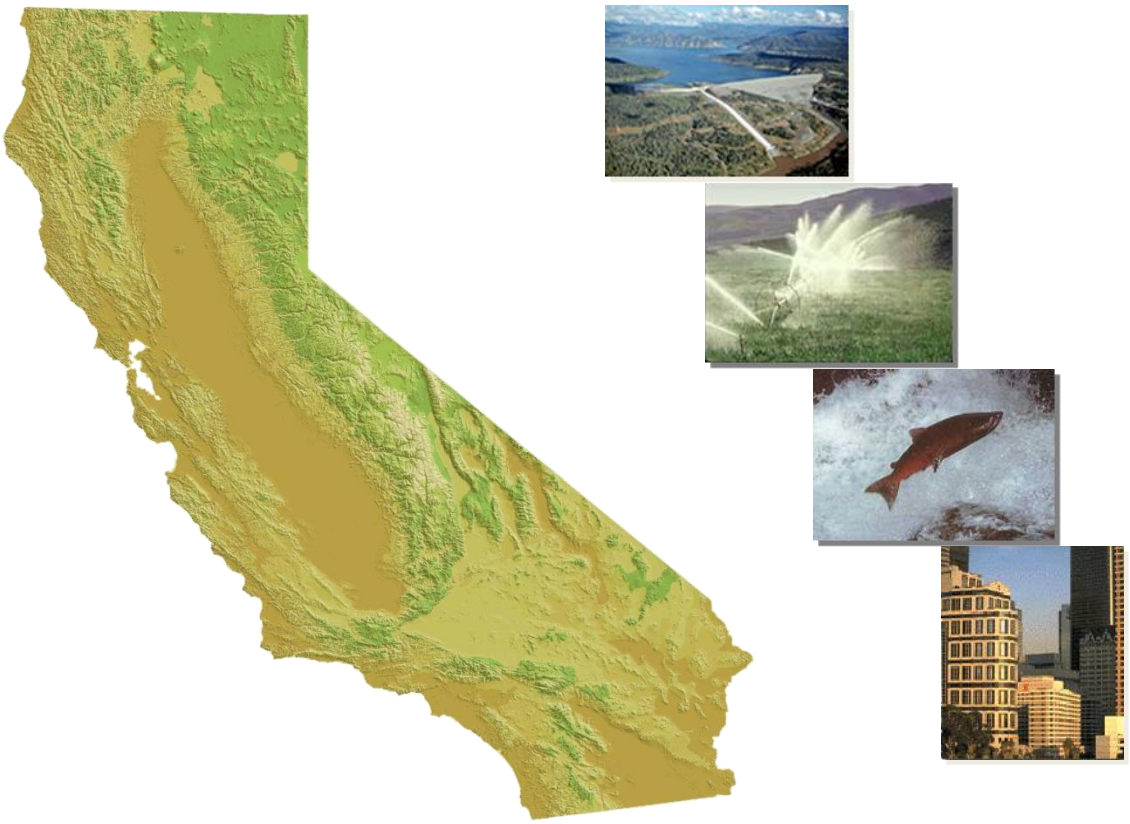
# California Water Plan Update 2013

## Applying the Sustainably Indicators Framework

October 29, 2013

## Workbook



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# Table of Contents

**CALIFORNIA WATER PLAN, UPDATE 2013**
**PLENARY 2013**
**OCTOBER 29, 2013, 10:15 AM – 12:15 PM**
**APPLYING THE SUSTAINABILITY INDICATORS FRAMEWORK**

*Session Key Topics*

*1. Sustainability Indicators – statewide and regional*
*2. California's Water Footprint - statewide*

## AGENDA

| # | TIME | ITEM | PRESENTERS/GROUP DISCUSSION LEADS |
|---|---|---|---|
| 1. | 10:15 AM | WELCOME, AND INTRODUCTIONS | Abdul Khan, Rich Juricich, and Elizabeth Patterson (Facilitator), Department of Water Resources (DWR) |
| 2. | 10:20 | SESSION OVERVIEW & SUMMARY OF WORK CONDUCTED<br>1. Purpose<br>2. Key contents<br>3. Key messages<br>4. Questions for reviewers | Abdul Khan, DWR |
| 3. | 10:30 | TESTING SUSTAINABILITY INDICATORS WITH PILOT STUDIES – STATEWIDE AND REGIONAL<br>– **Water Quality**<br>– **Ecosystem Health**<br>– **Adaptive and Sustainable Management**<br>– **Social Benefits and Equity**<br><br>*(Ref: CWP 2013,v1, Ch 5; pg 5-15 to 5-21; Table 5-5; Figures 5-19, 5-20, 5-22 to 5-31)* | Fraser Shilling, UC Davis |
| | 10.40 | GROUP REVIEW AND DISCUSSION | Fraser Shilling, UC Davis; Abdul Khan and Rich Juricich, DWR; Facilitator; All |
| | 11:20 | GROUP REPORT | Facilitator, All |
| 4. | 11:30 | TESTING SUSTAINABILITY INDICATORS WITH PILOT STUDIES – STATEWIDE<br>– **California's Water Footprint**<br><br>*(Ref: CWP 2013,v1, Ch 5; pg 5-15 to 5-18; Figure 5-21; Box 5-5, Box 5-5 Figure A)* | Heather Cooley, The Pacific Institute |
| | 11.40 | GROUP REVIEW AND DISCUSSION | Heather Cooley and Julian Fulton, The Pacific Institute; Vance Fong and Don Hodge, US Environmental Protection Agency; Facilitator; All |
| | 12:00 | GROUP REPORT | Facilitator, All |
| 5. | 12:10 | NEXT STEPS | Rich Juricich, DWR |
| 6. | 12:15 | ADJOURN | Rich Juricich, DWR |



*If you need reasonable accommodations due to a disability, please contact Karina Ortega* 916-653-8036, TDD (916) 653-6934.

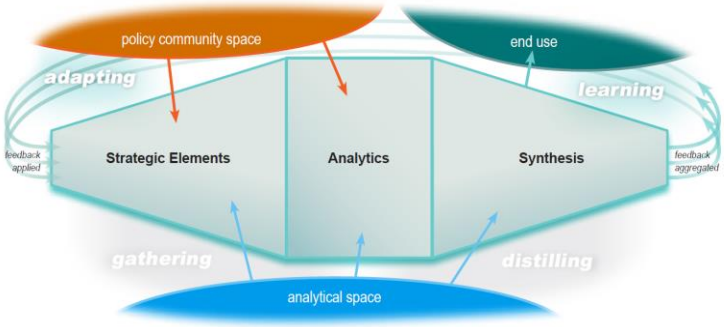
# California Water Plan Update 2013

## Applying the Sustainably Indicators Framework

October 29, 2013

# Presentations

1. **Session Overview and Summary of Work– Abdul Khan**




2. **Managing for Water Sustainability in an Uncertain Future– Fraser Shilling**

Questions:

1. How broadly should indicators be used in measuring and reporting on water sustainability?
2. How should stakeholder interests and inputs be included in developing and evaluating indicators?

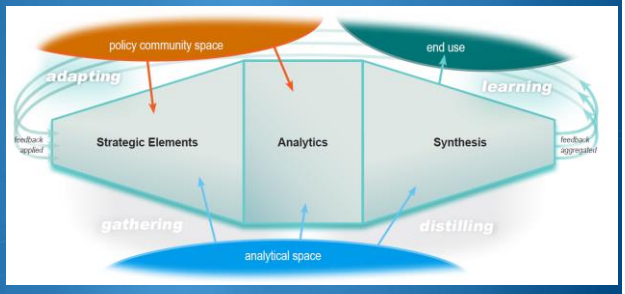
3. **California's Water Footprint: Major Findings and Discussion – Heather Cooley**

Questions:

1. How does the water footprint indicator affect working definitions of sustainability for state planning?
2. Should water management in California consider water resources elsewhere? Are there risks that should be understood and mitigated?

# Public Review Draft *Applying the Sustainability Indicators Framework*

## Session Overview
## Summary of Work




## California Water Plan Plenary

October 29, 2013

## Update 2013 Public Review Draft
### Sustainability Indicators Framework
### Purpose

- **Quantitatively monitor progress to meeting water sustainability goals and objectives through the development and application of an analytical framework.**

CALIFORNIA WATER PLAN UPDATE 2013

# Update 2013 Public Review Draft
## Sustainability Indicators Framework
## Key Contents

- Analytical approach
- Sustainability goals and objectives
- Indicators – by goals and domains
- Water footprint
- Statewide and regional Pilots
- Web-based decision support tool

1. Summary – CWP Vol. 1
2. Details – CWP Vol. 4
3. Decision support tool: indicators.ucdavis.edu

CALIFORNIA WATER PLAN UPDATE 2013

# Update 2013 Public Review Draft
## Sustainability Indicators Framework
## Collaboration/Coordination

- DWR, US EPA, UC Davis, the Pacific Institute
- Strategic Growth Council
- Sustainable Water Resources Roundtable
- CDPH Healthy Community Indicators Project
- US EPA Healthy Watersheds Initiative

- The Delta Plan
- California Healthy Streams Partnership
- Bay Institute's Ecological Scorecard Project
- Water Research Foundation
- Alliance for Water Stewardship
- Governor's Office of Planning and Research

CALIFORNIA WATER PLAN UPDATE 2013

# Update 2013 Public Review Draft
## Sustainability Indicators Framework- Key Messages

1. **The Framework provides a systematic approach to apply indicators to measure progress.**
2. **The Pilots demonstrate that the Framework, with web-based decision support, could be an effective tool in tracking and evaluating progress towards resource sustainability.**
3. **Many California programs and agencies are increasingly considering the use of indicators to measure progress:**

SGC's 2010 CA Regional Progress Report: *"Indicators reports provide data and information about important issues and trends.." "They are most effective when used to inform decision-making and engage policy makers, managers, planners, and residents in taking action to improve outcomes."*

A Guiding Principle in the Water Plan: *"Determine values for economic, environmental, and social benefits; costs; and tradeoffs so as to base investment decisions on sustainability indicators."*

OPR, CA's Climate Future – A Discussion Draft of the Env. Goals and Policy Report 09-30-2013 – The Role of Metrics: *"It is critical to track progress and gauge success moving forward. "*

CALIFORNIA WATER PLAN UPDATE 2013

# Update 2013 Public Review Draft
## Questions for Reviewers

### Sustainability Indicators

1. **How broadly should indicators be used in measuring and reporting on water sustainability?**
2. **How should stakeholder interests and inputs be included in developing and evaluating indicators?**

### Water Footprint

1. **How does the water footprint indicator affect working definitions of sustainability for state planning?**
2. **Should water management in California consider water resources elsewhere? Are there risks that should be understood and mitigated?**

CALIFORNIA WATER PLAN UPDATE 2013

# NOTES

# NOTES

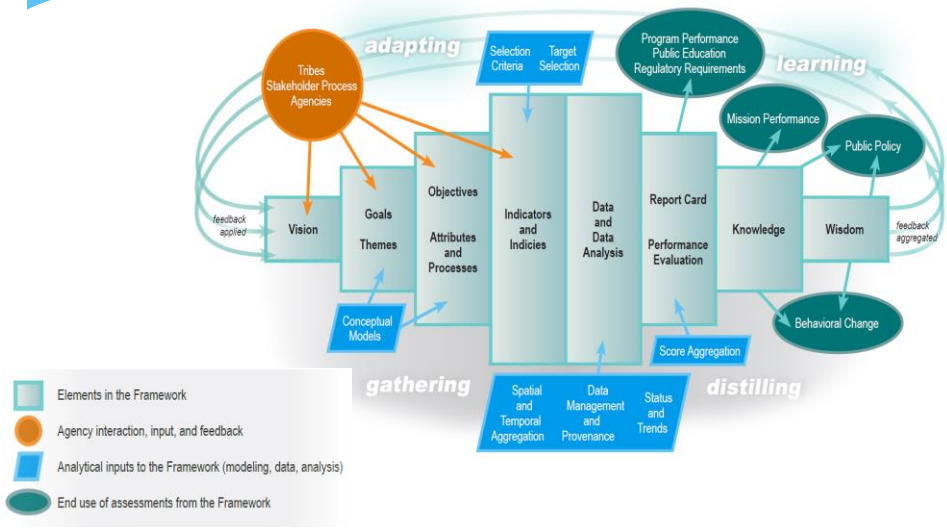
# Managing for Water Sustainability in an Uncertain Future

Fraser Shilling, Iara Lacher, Susana Cardenas, & David Waetjen (UC Davis)

with
Abdul Khan, Rich Juricich, & Kamyar Guivetchi (DWR)
Vance Fong & Don Hodge (USEPA)
Council for Watershed Health & SAWPA
Pacific Institute

indicators.ucdavis.edu

# Sustainability Indicator Framework



# Water Sustainability Goals

| Water Plan Update 2013 | SAWPA One Water One Watershed 2.0 |
|---|---|
| Goal 1. Manage and make decisions about water in a way that integrates water availability, environmental conditions, and community well-being for future generations. | Goal 1: Maintain reliable and resilient water supplies and reduce dependency on imported water |
| Goal 2. Improve water supply reliability to meet human needs, reduce energy demand, and restore and maintain aquatic ecosystems and processes. | Goal 2: Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities |
| Goal 3. Improve beneficial uses and reduce impacts associated with water management. | Goal 3: Preserve and enhance the ecosystem services provided by open space and habitat within the watershed |
| Goal 4. Improve quality of drinking water, irrigation water, and in-stream flows to protect human and environmental health. | Goal 4: Protect beneficial uses to ensure high quality water for human and natural communities |
| Goal 5. Protect and enhance environmental conditions by improving watershed, floodplain, and aquatic condition and processes. | Goal 5: Accomplish effective, equitable and collaborative integrated watershed management in a cost-effective manner |
| Goal 6. Integrate flood risk management with other water and land management and restoration activities. | |
| Goal 7. Employ adaptive decision-making, especially in light of uncertainties, that support integrated regional water management and flood management systems. | |

# Sustainability Indicators: California

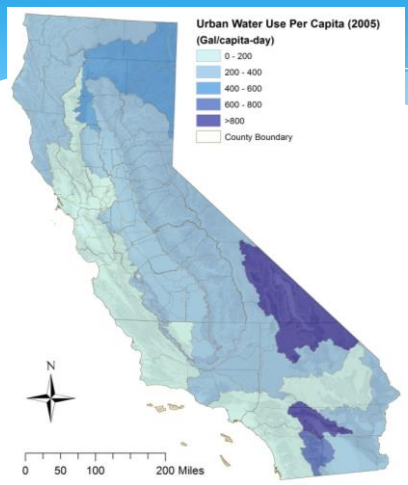
| Indicator Name | Sustainability Goals |
|---|---|
| Aquatic Fragmentation | 5 |
| Baseline Water Stress | 1,2 |
| California Stream Condition Index | 5 |
| CalEnviroScreen-Groundwater Threats | 4 |
| Geomorphic Condition | 5,6 |
| Groundwater Quality-Nitrate | 4 |
| Groundwater Stress | 2 |
| Historical Drought Severity | 2,5 |
| Historical Flooding | 6 |
| Interannual variability | 2,5,7 |
| Native Fish Species | 5 |
| Public Perceptions of Water | 7 |
| Return Flows | 2,3 |
| Threats to Amphibians | 5 |
| Upstream Protected Lands | 2,4 |
| Upstream Storage | 2,3 |
| Water Footprint | 1,2,7 |
| Water Quality Index | 4 |
| Water Use and Availability | 2 |

State pilot indicators and indices and corresponding Sustainability Goals. 19 of 120 indicators in the Water Plan Sustainability Indicators Framework

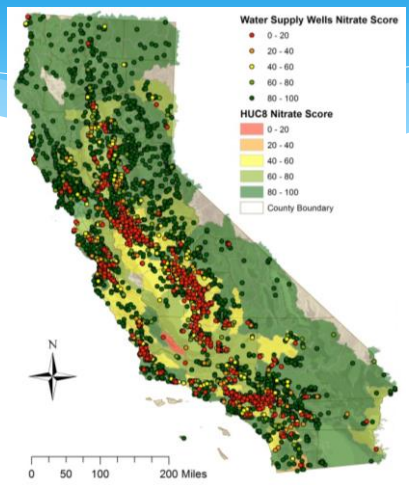
# Sustainability Indicators: SAWPA

| Indicator Name | SAWPA OWOW 2.0 Sustainability Goal |
|---|---|
| Proportion of Water Use from Imported and Recycled Sources | 1 |
| Water Use (per capita) | 1 |
| Local Water Supply Reserves | 1 |
| Adoption of Sustainable Water Rates | 1 |
| Water Availability and Stress (WRI Aqueduct 2.0) | 1 |
| Annual Water Resource Energy Use Relative to Rolling Average | 1 |
| Stream Network with Natural Substrate Benthos | 2 |
| Impervious Surface: Water Quality Index and Geomorphic Condition | 2,4 |
| Coastal Impacts from Sea Level Rise | 3,5 |
| Aquatic Habitat Fragmentation | 2 |
| Open Space for Recreation | 3 |
| Invasive Species and Native Landscapes | 3 |
| Area with Restoration Projects and Conservation Agreements | 3 |
| Exceedance of Water Quality Objectives in Watershed | 4 |
| Exceedance of Groundwater Salinity Standards | 4 |
| Exceedance of Water Quality Objectives at Discharge | 4 |
| Exceedance of Water Quality Objectives at Recreation Sites | 4 |
| Biological Condition Index | 3,5 |
| OWOW (Stakeholder-Community) Participation | 5 |

# Sample Findings: California

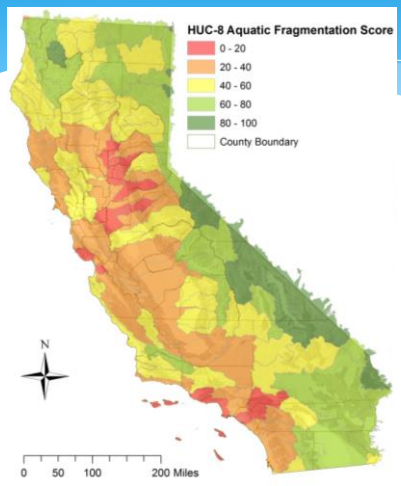



Water use by DWR planning area

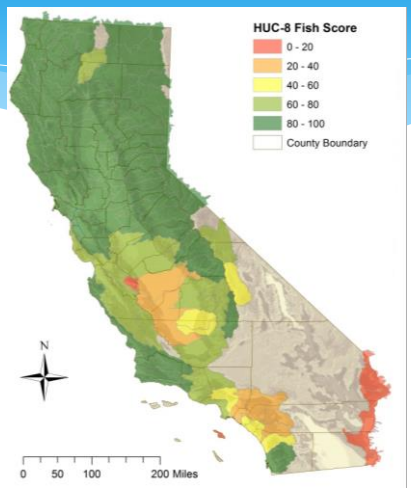



Water supply wells affected by nitrate contamination

# Sample Findings: California

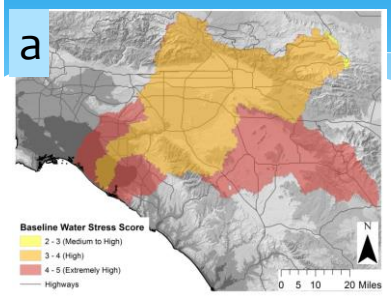


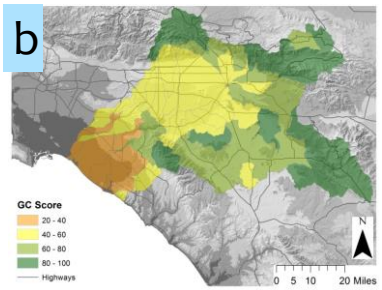

Aquatic fragmentation from road-stream crossings

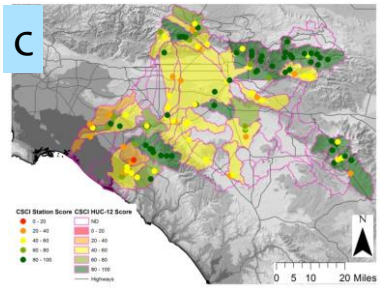



Current presence of native fish species relative to historic presence.

# Sample Findings: SAWPA




Evaluation of (a) "baseline water stress", (b) geomorphic condition (GC), and (c) California Stream Condition Index indicators at the SAWPA scale.

# Update 2013 Public Review Draft Questions for Reviewers

## Sustainability Indicators

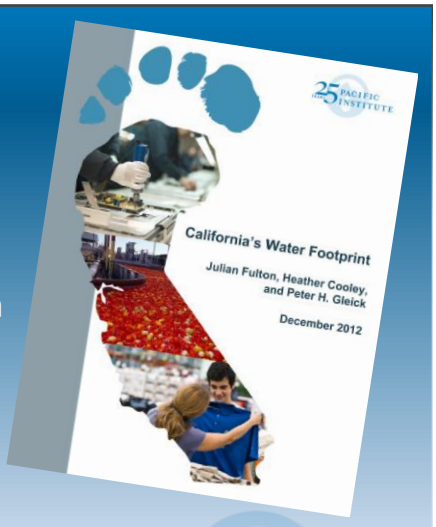
1. How broadly should indicators be used in measuring and reporting on water sustainability?
2. How should stakeholder interests and inputs be included in developing and evaluating indicators?

CALIFORNIA WATER PLAN UPDATE 2013

# NOTES

# NOTES

# California's Water Footprint:
## Major Findings and Discussion

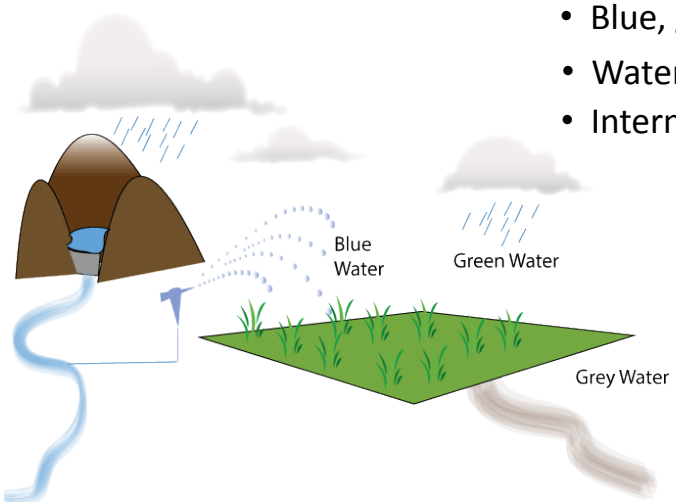



**Heather Cooley and Julian Fulton**
**Pacific Institute, UC Berkeley**
California Water Plan, Update 2013
Plenary 2013
October 29, 2013, 10:15 AM- 12:15 PM

1

# Water Footprint Definitions

- Blue, green, and grey
- Water consumption
- Internal and external

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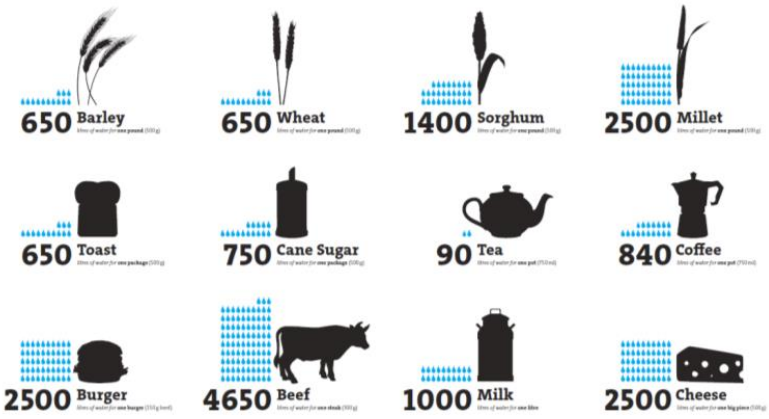
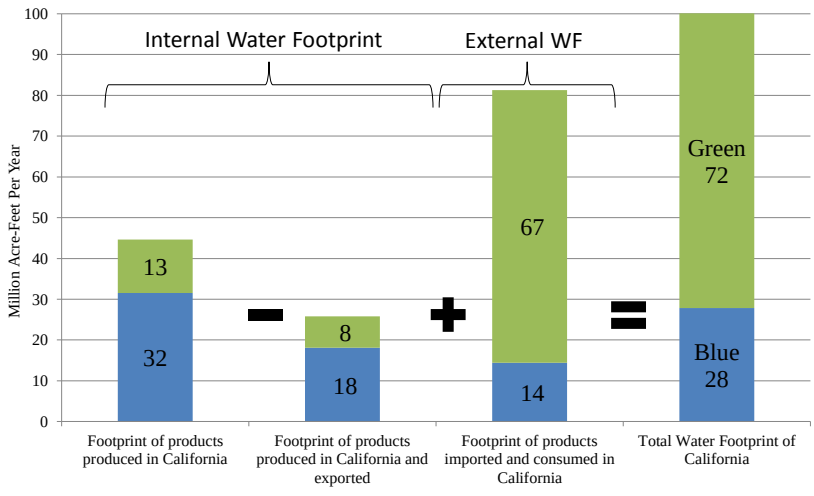
# Examples



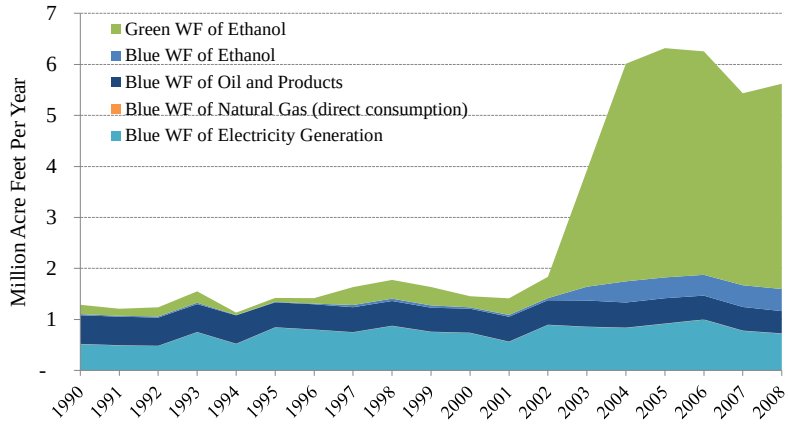

Source: http://virtualwater.eu/



# California's Water Footprint in 2010

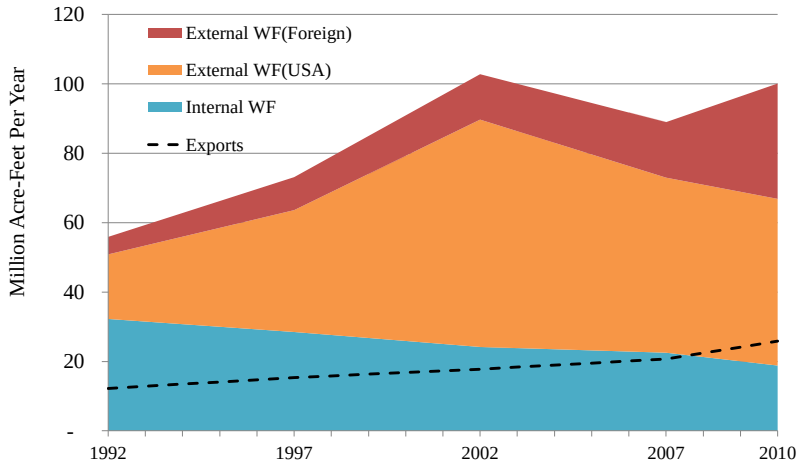


# Water Footprint of Energy






# California's Water Footprint, 1992- 2010



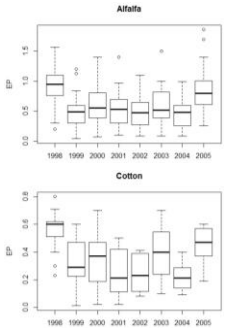
# Sources of Variation

- Like all measurements, the water footprint has several types and sources of variation. An individual's WF can vary with income, diet, and consumption patterns. California's WF for agricultural production varied due to variations in crop-specific irrigation and evapotranspiration rates, which affects the CA-WF.

**Table 1. % Change in CA Water Footprint and its components due to variability of water footprints of the nine main crops statewide**

| | 1992 | 1997 | 2002 | 2007 |
|---|---|---|---|---|
| **% Change in CA Water Footprint of Agricultural Production** | | | | |
| **Lower bound*** | -27% | -27% | -27% | -26% |
| **Upper bound*** | +33% | +33% | +34% | +33% |
| **% Change in CA Blue Water Footprint** | | | | |
| **Lower bound*** | -24% | -24% | -20% | -23% |
| **Upper bound*** | +29% | +29% | +25% | +29% |
| **% Change in CA Water Footprint** | | | | |
| **Lower bound*** | -12% | -10% | -7% | -8% |
| **Upper bound*** | +14% | +12% | +9% | +10% |

Note: * Lower and upper bounds of the 95% confidence interval.






# Questions for Reviewers

- How does the water footprint indicator affect working definitions of sustainability for state planning?
- Should water management in California consider water resources elsewhere? Are there risks that should be understood and mitigated?

# NOTES

# NOTES

# California Water Plan Update 2013

## Applying the Sustainably Indicators Framework

October 29, 2013

# Handouts

1. **Managing an Uncertain Future: Applying the Sustainability Indicators Framework – California's Water Sustainability Indicators**

2. **Managing an Uncertain Future: Applying the Sustainability Indicators Framework – California's Water Footprint**

3. **Indicators by Goals**

4. **Indicators by Domains/Categories**

# Chapter 5 Managing an Uncertain Future

## Related Sessions at the Water Plan Plenary

*October 29th 10:15 am – Applying the Sustainability Indicators Framework*

*October 30th 11:15 am – Central Valley Vulnerability Analysis and Response Strategies*

## About This Chapter

Chapter 5, "Managing an Uncertain Future," emphasizes the need for decision-makers, water and resource managers, and land use planners to use a range of considerations in planning for California's water future in the face of many uncertainties and risks. It provides examples of uncertainties and discusses the need to assess risks in planning for actions with more sustainable outcomes. An approach is presented for evaluating resource management strategies for robustness by using multiple future scenarios. Water management vulnerabilities are presented. A framework is provided to measure the sustainability of water management policies and projects. This chapter describes the following topics:

- Recognizing and Planning for Risk and Uncertainty.
- Water Scenarios 2050: Possible Futures.
- Managing for Sustainability.
- California's Water Footprint

## California's Water Sustainability Indicators

**1. Key features of text**

The California Water Plan Update 2013 includes 120 Water Sustainability Indicators, which are a way to measure how sustainably we are using water and aquatic systems in California. The indicators are organized into a Framework (the Water Sustainability Indicator Framework, Figure 1) that has several important features: 1) The Framework is based on sustainability goals and sustainability domains. The goals are statements of social intent about water and water management. The domains are categories of condition and management (e.g., water quality) relevant to understanding water sustainability; 2) When indicators are evaluated, the resulting scores can be aggregated to report on how well we are meeting water sustainability goals, and the status and trends in condition of our part of the water cycle; 3) The indicator scores are based on the idea that in order to know how water-sustainable we are, we need to set targets for desired and un-desired condition for each indicator. Sustainability scoring is accomplished by measuring the departure from desired and un-desired targets; and 4) The indicators, information required to evaluate the indicators, and the results of the evaluation are all reported using an online decision-support tool: http://indicators.ucdavis.edu. The tool includes a description of the sustainability indicators, a mapping tool showing the results of indicator scoring, and a catalog of >1,860 sustainability indicators from >40 frameworks from around the world.

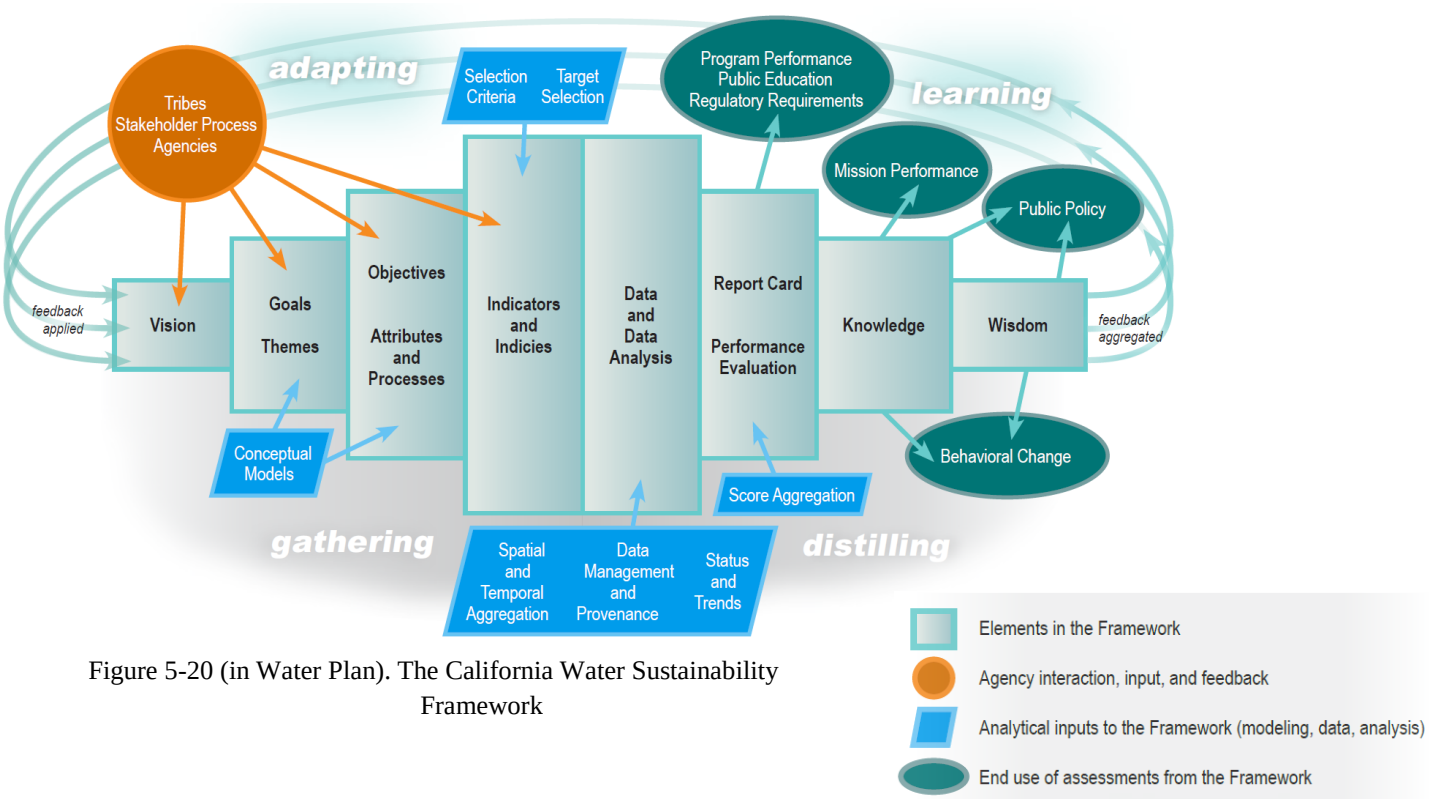



Figure 5-20 (in Water Plan). The California Water Sustainability Framework

Water sustainability indicators come in many flavors, including the Water Footprint (described in an accompanying presenatation). A few examples are included of mapped (Figures 2 & 3) and non-mapped (Figure 4) indicators. A key indicator for the Water Plan is water use, especially in relation to policies for water conservation, like the "20 by 2020" policy, which refers to 20% reduction in urban water use by the year 2020 (compared to the baseline year, 2005). Large urban areas near the coast appear to be on track to meet their 2020 targets, whereas inland communities don't (Figure 2a). Nitrate contamination in groundwater is an important inhibiting limiting factor for the use of groundwater for drinking. A scoring approach where a score of "0" is received for violating the EPA standard for drinking water of 9 mg/L nitrate-nitrogen and a score of 100 is received for concentrations <1 mg/L (background concentrations in the Tulare Basin). Urban and Central Valley wells and areas often receive low scores for nitrate in groundwater (Figure 2b). Fragmentation of aquatic systems from road crossings and dams can limit natural processes in streams and rivers. Most California watersheds have enough road-stream crossings to cause potential problems with stream ecology and thus low sustainability scores (Figure 3a). Native fish species are still present in most California watersheds that have been surveyed. However, many water-bodies in Southern California are missing all or most of their native fish species (Figure 3b). These indicators and others are described and for some, evaluation results included, at the Water Sustainability Decision Support Tool website: http://indicators.ucdavis.edu.

**2a** **2b**

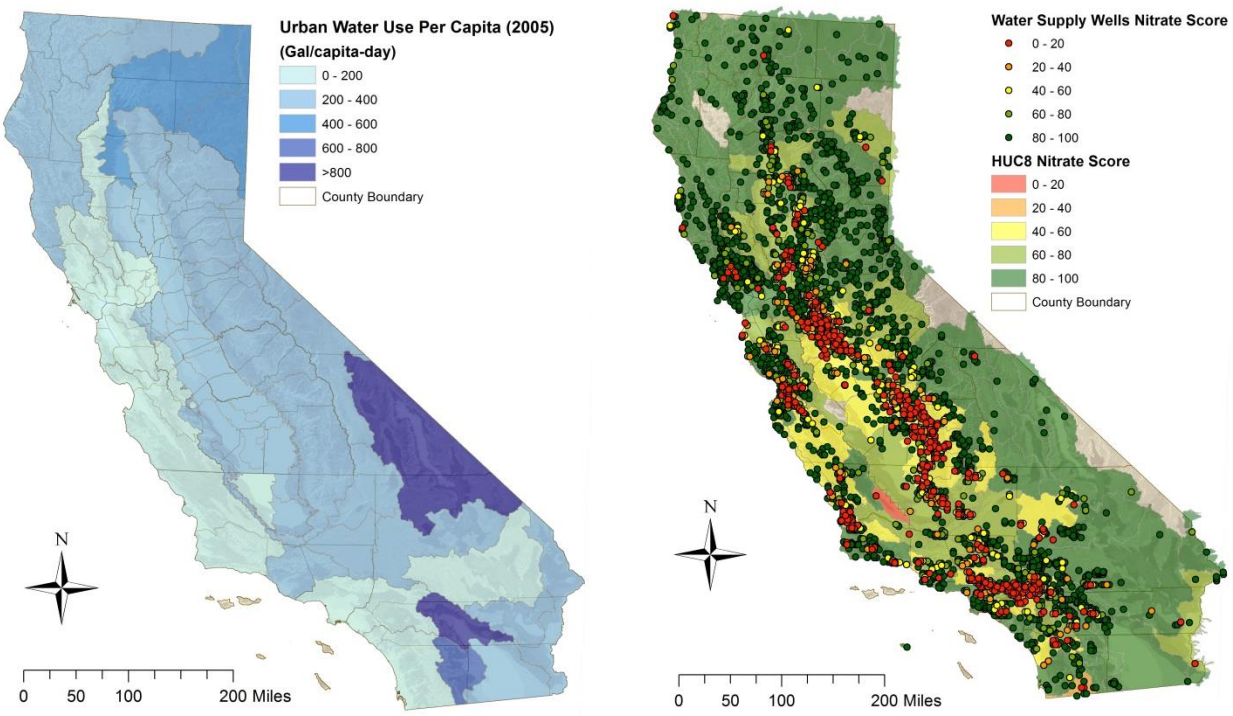



Figure 2: (a) Water use by DWR planning area and (b) water supply wells affected by nitrate contamination. These figures are not in the current WP Draft, but will be in the final.

**3a** **3b**

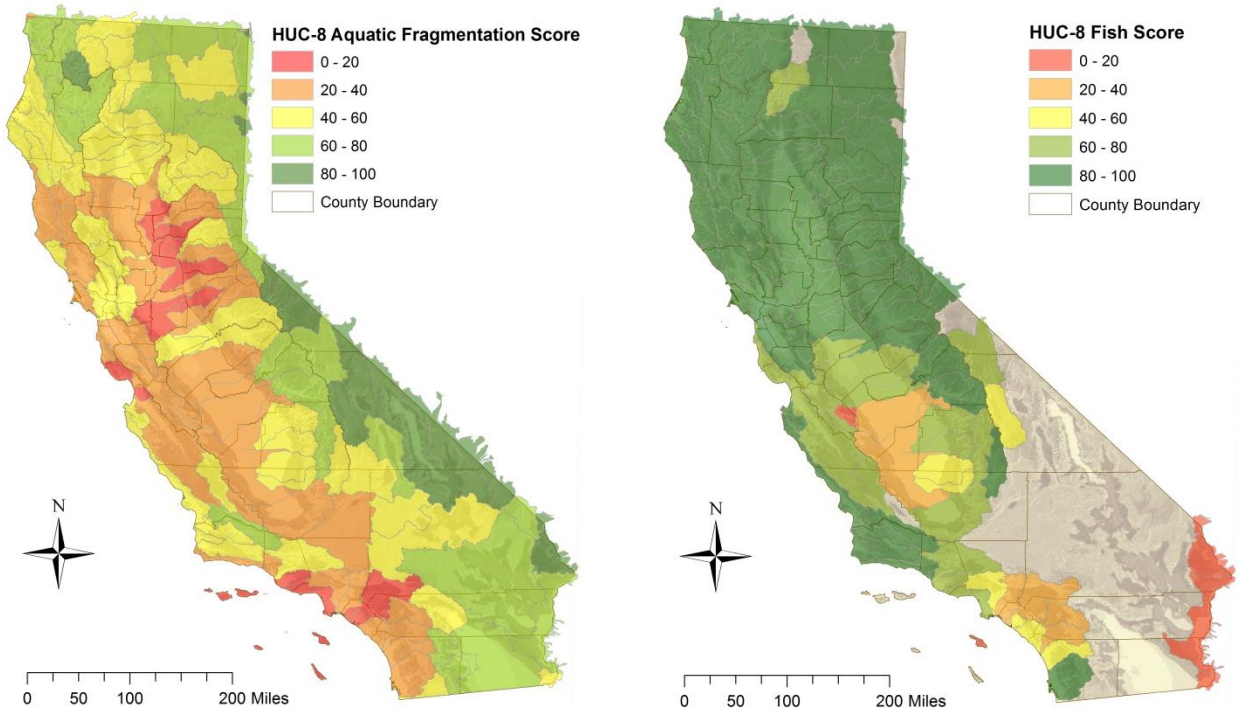
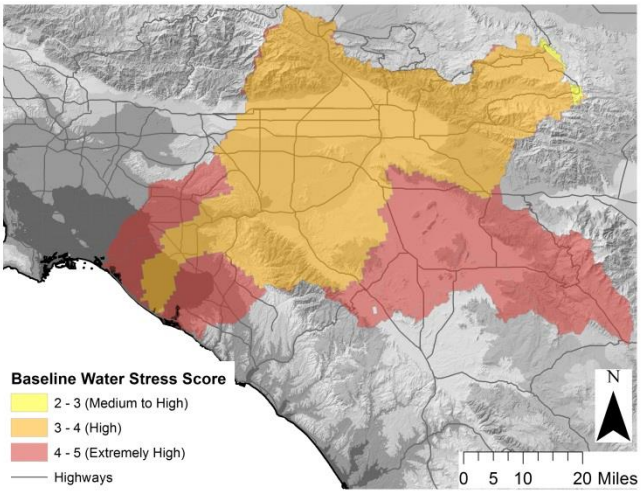


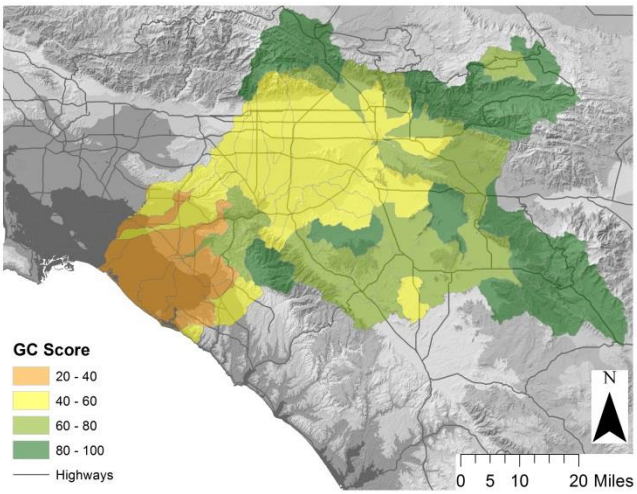

Figure 3: (a) Aquatic fragmentation from road-stream crossings and (b) current presence of native fish species relative to historic presence. These figures will be in the final draft WP.

Indicators were also evaluated at the regional scale. Over a dozen regions in California were surveyed and considered before the Santa Ana Watershed Project Authority (SAWPA) area was selected as a partner. The Council for Watershed Health, SAWPA, and UC Davis followed the Framework and developed and evaluated a set of 5 goals and 19 corresponding indicators as part of the SAWPA One Water One Watershed (OWOW) 2.0 process. The successful implementation of the Framework at the regional scale suggests that other regions could use a similar approach as part of Integrated Regional Water Management, or similar local or regional water and sustainability planning.

**4a**




**4b**




**4c**

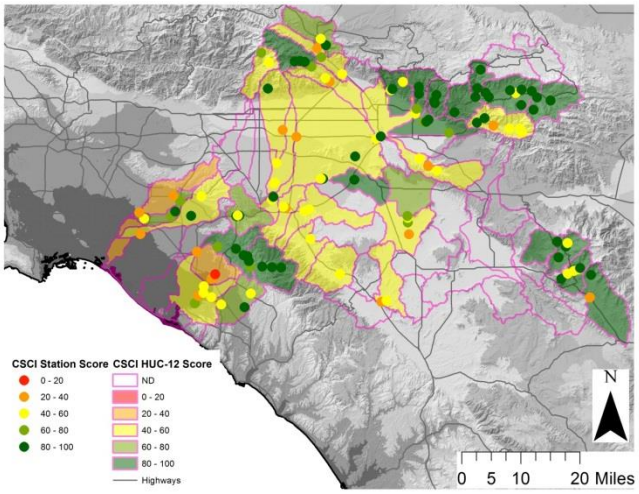



Figure 4: Evaluation of (a) "baseline water stress", (b) geomorphic condition (GC), and (c) California Stream Condition Index indicators at the SAWPA scale. These figures are not in the current WP Draft, but will be in the final.

**2. What is new / different from Update 2009? / What has changed since last draft?**

Although the 2009 Update included a discussion of sustainability indicators, no detailed guidance or indicator evaluation was carried out. The 2013 Update includes the first detailed description of how to measure sustainability using indicators at both the state and region scale. The final Update will include all of the technical documentation for the indicator evaluations, which will also be descried and made available at: http://indicators.ucdavis.edu.

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**3. What public input has been received to date?**

- Presented Framework approach and contents to the Water Plan Public Advisory Committee in March and December, 2011.
- Presented Framework approach and contents the Tribal Advisory Committee in May, August, and December, 2011.
- Reviewed Framework approach with the State Agency Steering Committee in June 2011.
- Reviewed Framework approach, pilots, results, and comments and feedback with the multi-agency Water Sustainability work group in July and October, 2011, and August 2012.
- Reviewed Framework approach in a Sustainability Indicators Workshop in August 2011.
- Presented Framework approach and contents at the Water Plan Plenary meeting in October 2011and September 2012.
- Presented Framework approach and pilot study concepts at the Sustainability Water Resources Roundtable meeting in December 2011.

## Questions to Consider

- How broadly should indicators be used in measuring and reporting on water sustainability?
- How should stakeholder interests and inputs be included in developing and evaluating indicators?
- How does target setting for water sustainability affect findings useful for state planning?
- How can we roll-up local and regional indicator use to larger geographic extents (e.g., the state)?

# Chapter 5 Managing an Uncertain Future

## Related Sessions at the Water Plan Plenary

*October 29th 10:15 am – Applying the Sustainability Indicators Framework*

*October 30th 11:15 am – Central Valley Vulnerability Analysis and Response Strategies*

## About This Chapter

Chapter 5, "Managing an Uncertain Future," emphasizes the need for decision-makers, water and resource managers, and land use planners to use a range of considerations in planning for California's water future in the face of many uncertainties and risks. It provides examples of uncertainties and discusses the need to assess risks in planning for actions with more sustainable outcomes. An approach is presented for evaluating resource management strategies for robustness by using multiple future scenarios. Water management vulnerabilities are presented. A framework is provided to measure the sustainability of water management policies and projects. This chapter describes the following topics:

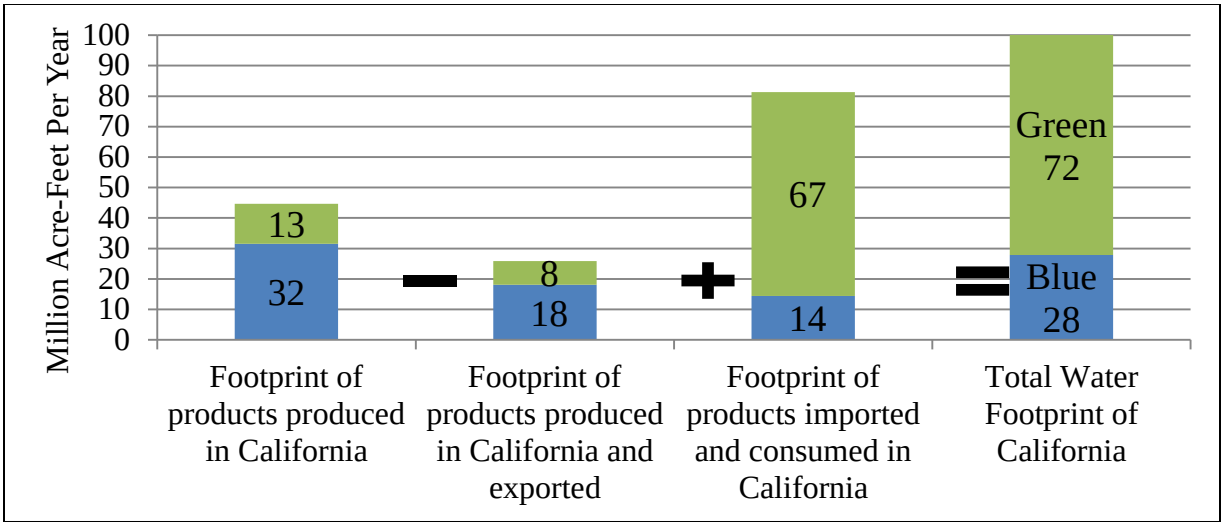
- Recognizing and Planning for Risk and Uncertainty.
- Water Scenarios 2050: Possible Futures.
- Managing for Sustainability.
- California's Water Footprint

## California's Water Footprint

**1. Key features of text**

The California Water Plan Update 2013 includes California's Water Footprint as a broad index of demand for water resources by the people of California. The State's water footprint is a measure of the total volume of freshwater that is used to produce the goods and services consumed by Californians. Water footprint assessments address the complex ways in which humans interact with the water cycle. Much of this complexity has to do with the global nature of California's economy, where goods and services are traded across regions, states, and among distant countries. For Californians, the goods and services we consume might be produced in many different places around the world. Thus, California affects and is affected by water resource conditions in other countries and other parts of the United States. A change in water availability elsewhere could affect not only California's economy, but also the way water is used here. The California Water Sustainability Indicators Framework definition of sustainability therefore implies a need to recognize water use not only within California but also in locations from where the products consumed in California are produced. The Water Footprint index helps address this complex task in a systematic way and may be used to address important issues related to sustainable water use in the state.

**Figure 5-17: California's Water Footprint, 2010**




**Volume 4, Figure 5: California's Energy-Related Water Footprint**

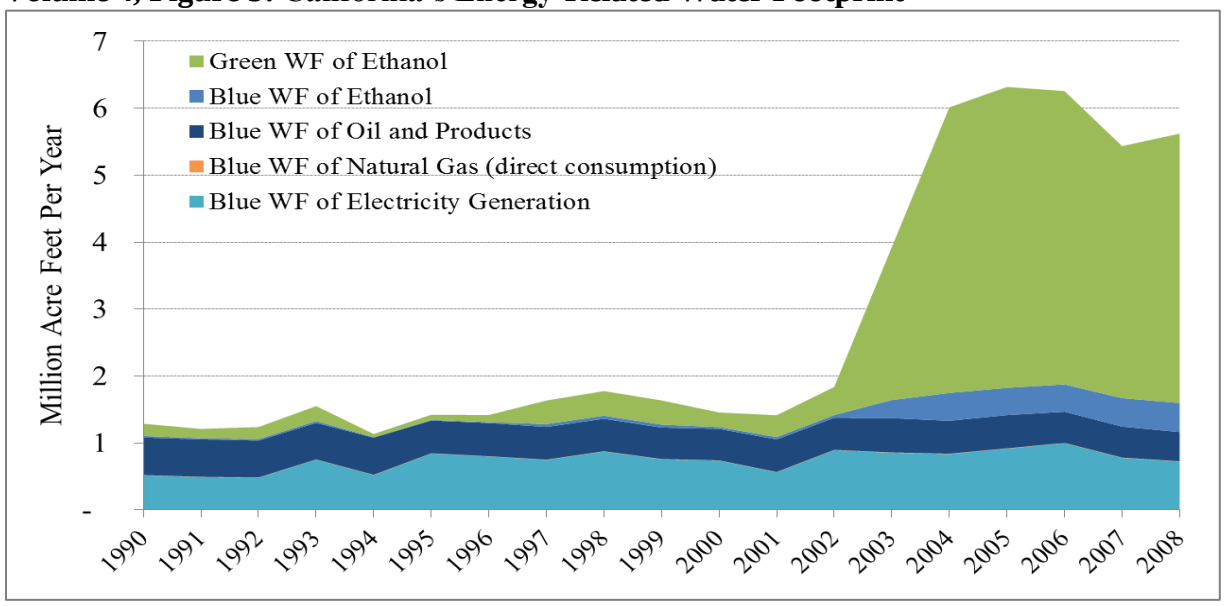
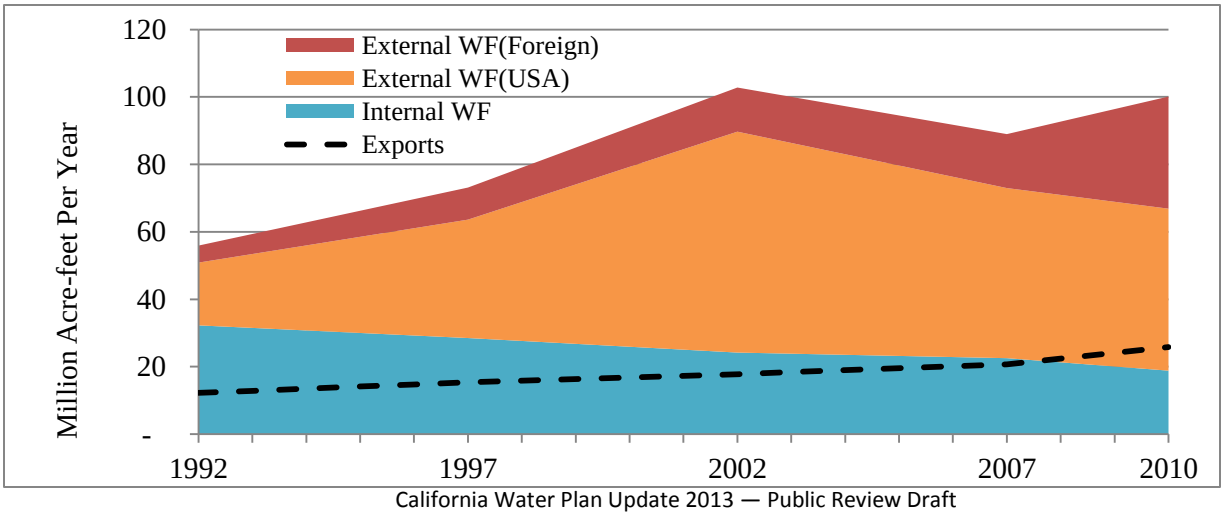



**Figure A in Box 5-5: California's Water Footprint, 1992-2010**



**2. What is new / different from Update 2009? / What has changed since last draft?**

The Water Footprint was not included in Update 2009, as this is the first comprehensive water footprint of California that has been conducted. We did, however, present preliminary results at the 2012 Plenary. Since that time, we have expanded the water footprint to include the water use associated with California's energy use. We have also expanded the analysis to include data from 1992 through 2010 and have disaggregated water footprint data to evaluate the water requirements of production and consumption for various hydrologic regions in California. Finally, we have described sources of variations in the state's water footprint.

**3. What public input has been received to date?**

- Presented Framework approach and contents to the Water Plan Public Advisory Committee in March and December, 2011.
- Presented Framework approach and contents the Tribal Advisory Committee in May, August, and December, 2011.
- Reviewed Framework approach with the State Agency Steering Committee in June 2011.
- Reviewed Framework approach, pilots, results, and comments and feedback with the multi-agency Water Sustainability work group in July and October, 2011, and August 2012.
- Reviewed Framework approach in a Sustainability Indicators Workshop in August 2011.
- Presented Framework approach and contents at the Water Plan Plenary meeting in October 2011and September 2012.
- Presented Framework approach and pilot study concepts at the Sustainability Water Resources Roundtable meeting in December 2011.

## Questions to Consider

- How does the water footprint indicator affect working definitions of sustainability for state planning?
- How broadly should water management in California consider water resources elsewhere? Are there risks that should be understood and mitigated?
- How should the water-related costs and benefits of exports be considered alongside other water management criteria?

# Indicators by Goal

For the full description please go to: http://indicators.ucdavis.edu/indicators

## Goal 1: Sustainable Water Management

1. Aquifer Declines
2. Baseline Water Stress (WRI)
3. Benefits from Water Management
4. Completion of Stewardship Actions
5. Drought Resilience
6. Energy Requirements for Water Delivery
7. Equitable Decision-Making Process
8. Flood Resilience
9. Greenhouse Gas Emissions
10. Groundwater Stress (WRI)
11. Historical Drought Severity (WRI)
12. Historical Flooding Occurrence (WRI)
13. Inter-annual Variability (WRI)
14. Participation in Local Stewardship
15. Potentially Unhealthy Water Supply
16. Storm Resilience
17. Sustainable Water Usage
18. Water Demand
19. Water Risk (WRI)
20. Water Scarcity Index
21. Water Stress Index
22. Water Travel Distance

## Goal 2: Improve Water Supply

1. Affordable Water Prices
2. Aquifer Declines
3. Available Water (WRI)
4. Baseline Water Stress (WRI)
5. Delta: Percent Water Supplied
6. Delta: Water Usage
7. Drought Resilience
8. Earthquake Resilience
9. Energy Requirements for Water Delivery
10. Forest Land Conversion
11. Groundwater Stress (WRI)
12. Managed Geomorphic Flows
13. Non-potable Water Needs for Agriculture
14. Percent Recycled Water
15. Protected Aquifer Recharge Areas
16. Public support and awareness of water system protection.
17. Residential Water Use & Conservation
18. Return Flows (WRI)
19. Sustainable Water Usage
20. Upstream Protected Lands (WRI)
21. Upstream Storage (WRI)
22. Water Demand
23. Water Re-use
24. Water Risk (WRI)
25. Water Scarcity Index
26. Water Shortage
27. Water Storage and Use
28. Water Stress Index
29. Water Travel Distance

## Goal 3: Contribute to Social and Ecological Benefits from Water Management

1. Abundance of Key Native Species
2. Abundance of Key Non-Native Species
3. Benefits from Water Management
4. California Stream Condition Index
5. Coastal Economy: Commercial use rate of fish populations (MLPA)
6. Coastal Economy: Recreation use rate of specific areas
7. Delta: Agricultural Improvements
8. Delta: Dependent Industrial Production
9. Delta: Fishing
10. Delta: Percent Water Supplied
11. Delta: Recreational Use
12. Delta: Recycled Water Usage
13. Delta: Water Usage
14. Equitable Access to Clean Water
15. Flow Patterns
16. Flows for Fish
17. Groundwater: CalEnviroScreen
18. Index of Biotic Integrity
19. Jobs and Water Transfers
20. Land Subsidence
21. Mercury in Fish Tissue
22. Native Fish Community
23. Native Fish Habitat and Flow
24. Potentially Unhealthy Water Supply
25. Protected Aquifer Recharge Areas
26. Riparian Habitat
27. Support of Environmental Measures and Regulation
28. Trophic State Index
29. Water Recycling and Stream Flow
30. Water Transfer Benefits to Local Economies
31. Water Transfer Costs and Benefits
32. Water Travel Distance

## Goal 4: Increase Quality of Water

1. Abundance of Key Non-Native Species
2. Amount of Industrial Pollutants Released
3. California Stream Condition Index
4. Delta: Water Quality and Irrigated Lands
5. Equitable Access to Clean Water
6. Fertilizer Application Rate
7. Groundwater: CalEnviroScreen
8. Groundwater Nitrate
9. Groundwater Water Quality Index
10. Impervious Surface: Geomorphic Condition
11. Impervious Surface: Water Quality Index
12. Non-potable Water Needs for Agriculture
13. Percent Recycled Water
14. Periphyton Cover and Biomass
15. Pollutant and Bacteria Index
16. Potentially Unhealthy Water Supply
17. Upstream Protected Lands (WRI)
18. Water Treatment Cost

## Goal 5: Safeguard Environmental Health

1. Abundance of Key Native Species
2. Abundance of Key Non-Native Species
3. Amount of Industrial Pollutants Released
4. Aquatic Fragmentation
5. California Stream Condition Index
6. Channel Alteration
7. Coastal Biodiversity: Species diversity and richness (MLPA)
8. Coastal Economy: Commercial use rate of fish populations (MLPA)
9. Coastal Economy: Recreation use rate of specific areas
10. Coastal Fauna: Abundance of larval, juvenile, YOY fish
11. Coastal Fauna: Fledging rate of seabirds (MLPA)
12. Coastal Fauna: Focal invertebrate species (sea urchin, sea star, abalone), density and size (MLPA)
13. Coastal Fauna: Harbor seal abundance (MLPA)
14. Coastal Fauna: Planktivorous fish, density and size (MLPA)
15. Coastal Fauna: Predatory benthic invertebrates (soft-bottom, MLPA)
16. Coastal Fauna: Predatory, demersal fish (soft-bottom, MLPA)
17. Coastal Fauna: Predatory (piscivorous) fish, density and size (MLPA)
18. Coastal Fauna: Predatory (piscivorous) sea and shore birds, density and size (MLPA)
19. Coastal Fauna: Recruitment rate of fish
20. Coastal Fauna: Recruitment rate of invertebrates
21. Coastal Fauna: Surf zone fish assemblage (MLPA)
22. Coastal Fauna: Suspension feeders abundance and size (MLPA)
23. Coastal Habitat: Biogenic habitat, extent and structure of macroalgal/plant communities (MLPA)
24. Coastal Processes: Zonation and change in zonation of intertidal species (SLR)
25. Completion of Stewardship Actions
26. Conservation and Restoration Projects
27. Fertilizer Application Rate
28. Floodplain Restoration
29. Flow Patterns
30. Flows for Fish
31. Forest Land Conversion
32. Impervious Surface: Geomorphic Condition
33. Index of Biotic Integrity
34. Inter-annual Variability (WRI)
35. Managed Geomorphic Flows
36. Mercury in Fish Tissue
37. Native Fish Community
38. Native Fish Habitat and Flow
39. Periphyton Cover and Biomass
40. Plant Growth Index
41. Pollutant and Bacteria Index
42. Preservation of Natural Habitats
43. Riparian Habitat
44. Species Richness
45. Stream Bank Stability
46. Threats to Amphibians (WRI)
47. Trophic State Index
48. Unnatural Fire Regimes
49. Upstream Protected Lands (WRI)
50. Water Recycling and Stream Flow

51. Water Scarcity Index
52. Water Stress Index

## Goal 6: Integrate Flood Management Activities

1. Channel Alteration
2. Floodplain Protection
3. Floodplain Restoration
4. Flood Resilience
5. Flood Risk and Damage
6. Flow Patterns
7. Historical Flooding Occurrence (WRI)
8. Hydrostatic Force on Levees
9. Impervious Surface: Geomorphic Condition
10. Levee Maintenance
11. Levee Stability
12. Levee System Integrity Index
13. Managed Geomorphic Flows
14. Stream Bank Stability

## Goal 7: Improve Adaptive Decision Making

1. Adaptive Management under Changing Conditions
2. Collaboration between Scientists and Policy Makers
3. Communication of Uncertainty
4. Data Sharing and Distribution
5. Equitable Decision-Making Process
6. Groundwater Quantity (GRACE)
7. Participation in Local Stewardship
8. Plant Growth Index
9. Public support and awareness of water system protection.
10. Public Water Information Reporting System
11. Representation of Local Jurisdictions
12. Standardize Data Collection and Reporting
13. Stream Monitoring
14. Support of Environmental Measures and Regulation
15. Sustainable Water Usage
16. Workflow Processes

# Indicators by Domains/Categories

For the full description please go to: http://indicators.ucdavis.edu/indicators

## Adaptive and Sustainable Management

1. Adaptive Management under Changing Conditions
2. Baseline Water Stress (WRI)
3. Collaboration between Scientists and Policy Makers
4. Communication of Uncertainty
5. Completion of Stewardship Actions
6. Data Sharing and Distribution
7. Delta: Agricultural Improvements
8. Energy Requirements for Water Delivery
9. Equitable Decision-Making Process
10. Flood Resilience
11. Greenhouse Gas Emissions
12. Groundwater Quantity (GRACE)
13. Groundwater Stress (WRI)
14. Historical Drought Severity (WRI)
15. Historical Flooding Occurrence (WRI)
16. Inter-annual Variability (WRI)
17. Land Subsidence
18. Levee Maintenance
19. Levee Stability
20. Levee System Integrity Index
21. Participation in Local Stewardship
22. Plant Growth Index
23. Public support and awareness of water system protection.
24. Public Water Information Reporting System
25. Representation of Local Jurisdictions
26. Standardize Data Collection and Reporting
27. Stream Monitoring
28. Support of Environmental Measures and Regulation
29. Water Risk (WRI)
30. Water Stress Index
31. Water Travel Distance
32. Water Treatment Cost
33. Workflow Processes

## Ecosystem Health

1. Abundance of Key Native Species
2. Abundance of Key Non-Native Species
3. Aquatic Fragmentation
4. California Stream Condition Index
5. Channel Alteration
6. Coastal Biodiversity: Species diversity and richness (MLPA)
7. Coastal Economy: Commercial use rate of fish populations (MLPA)
8. Coastal Economy: Recreation use rate of specific areas
9. Coastal Fauna: Abundance of larval, juvenile, YOY fish
10. Coastal Fauna: Fledging rate of seabirds (MLPA)
11. Coastal Fauna: Focal invertebrate species (sea urchin, sea star, abalone), density and size (MLPA)
12. Coastal Fauna: Harbor seal abundance (MLPA)
13. Coastal Fauna: Planktivorous fish, density and size (MLPA)
14. Coastal Fauna: Predatory benthic invertebrates (soft-bottom, MLPA)
15. Coastal Fauna: Predatory, demersal fish (soft-bottom, MLPA)

16. Coastal Fauna: Predatory (piscivorous) fish, density and size (MLPA)
17. Coastal Fauna: Predatory (piscivorous) sea and shore birds, density and size (MLPA)
18. Coastal Fauna: Recruitment rate of fish
19. Coastal Fauna: Recruitment rate of invertebrates
20. Coastal Fauna: Surf zone fish assemblage (MLPA)
21. Coastal Fauna: Suspension feeders abundance and size (MLPA)
22. Coastal Habitat: Biogenic habitat, extent and structure of macroalgal/plant communities (MLPA)
23. Coastal Processes: Zonation and change in zonation of intertidal species (SLR)
24. Conservation and Restoration Projects
25. Floodplain Restoration
26. Flow Patterns
27. Flows for Fish
28. Forest Land Conversion
29. Impervious Surface: Geomorphic Condition
30. Index of Biotic Integrity
31. Inter-annual Variability (WRI)
32. Managed Geomorphic Flows
33. Native Fish Community
34. Native Fish Habitat and Flow
35. Periphyton Cover and Biomass
36. Plant Growth Index
37. Preservation of Natural Habitats
38. Riparian Habitat
39. Species Richness
40. Stream Bank Stability
41. Threats to Amphibians (WRI)
42. Trophic State Index
43. Unnatural Fire Regimes
44. Water Recycling and Stream Flow
45. Water Stress Index

## Social Benefits and Equity

1. Affordable Water Prices
2. Amount of Industrial Pollutants Released
3. Benefits from Water Management
4. Coastal Economy: Commercial use rate of fish populations (MLPA)
5. Coastal Economy: Recreation use rate of specific areas
6. Delta: Fishing
7. Delta: Recreational Use
8. Equitable Access to Clean Water
9. Equitable Decision-Making Process
10. Floodplain Protection
11. Flood Resilience
12. Flood Risk and Damage
13. Groundwater: CalEnviroScreen
14. Hydrostatic Force on Levees
15. Jobs and Water Transfers
16. Levee Maintenance
17. Mercury in Fish Tissue
18. Potentially Unhealthy Water Supply
19. Public support and awareness of water system protection.
20. Public Water Information Reporting System
21. Water Transfer Benefits to Local Economies

## Water Quality

1. Amount of Industrial Pollutants Released
2. California Stream Condition Index
3. Delta: Water Quality and Irrigated Lands
4. Fertilizer Application Rate
5. Groundwater: CalEnviroScreen

6. Groundwater Nitrate
7. Groundwater Water Quality Index
8. Impervious Surface: Geomorphic Condition
9. Impervious Surface: Water Quality Index
10. Mercury in Fish Tissue
11. Pollutant and Bacteria Index
12. Potentially Unhealthy Water Supply
13. Upstream Protected Lands (WRI)
14. Water Treatment Cost

## Water Supply Reliability

1. Affordable Water Prices
2. Aquifer Declines
3. Available Water (WRI)
4. Baseline Water Stress (WRI)
5. Delta: Dependent Industrial Production
6. Delta: Percent Water Supplied
7. Delta: Recycled Water Usage
8. Delta: Water Usage
9. Drought Resilience
10. Earthquake Resilience
11. Energy Requirements for Water Delivery
12. Groundwater Nitrate
13. Groundwater Stress (WRI)
14. Impervious Surface: Geomorphic Condition
15. Managed Geomorphic Flows
16. Non-potable Water Needs for Agriculture
17. Percent Recycled Water
18. Protected Aquifer Recharge Areas
19. Residential Water Use & Conservation
20. Return Flows (WRI)
21. Storm Resilience
22. Sustainable Water Usage
23. Upstream Protected Lands (WRI)
24. Upstream Storage (WRI)
25. Water Demand
26. Water Re-use
27. Water Risk (WRI)
28. Water Scarcity Index
29. Water Shortage
30. Water Storage and Use
31. Water Stress Index
32. Water Travel Distance
33. Water Transfer Costs and Benefits